STUDIES ON THE COTTON JASSID (EMPOASCA DEVASTANS DIST.) IN THE PUNJAB: IX. A CONSIDERATION OF THE LIGHT TRAP COLLECTIONS.

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Introduction

A very large number of species of insects are known to be positively phototropic. The economic entomologists have taken advantage of this peculiarity of these insects and have recommended light traps as a measure of control against some very serious crop pests. It is very unfortunate that no serious attempt seems to have been made in the subcontinent of India to study the phototropic response of the family Jassidae, particularly that of cotton jassid (*Empoasca devastans* Dist.), which is one of the major pests of cotton. The fact that no effective method of control of this pest is known at present, makes this study even more essential. To study this aspect of the behaviour of this important group of insects, and to explore the possibilities of its being used as a means of control, a preliminary attempt was made to collect jassids by means of a light trap.

Material and Method

A strong light trap with 100 candle power filament electric lamp emitting white light, at a height of 4 feet from ground level, was put up once a week, in an open place near the cotton fields (5 feet from the nearest field) at Lyallpur, from the middle of June, 1943 to the middle of June, 1944. The light trap was operated from dusk to dawn. All the insects collected were killed next morning by fumigation with carbon bisulphide. The jassids were then sorted out from the rest of the insects and counted. The total number of jassids collected, the percentage of *E. devastans* in the collection, and the percentage of females in the latter group, were worked out. These data are given in Table I.

It may be mentioned here that in this study a 100 candle power lamp was used only as a source of "strong" white light. It might perhaps have been more desirable to first carry out experiments with lights of varying intensities and different wave-lengths to find out the most effective light. It was, however, decided that for the preliminary study a 100 candle power white light would serve the purpose.

TABLE I

Date	Total Jassids	% of E. devastans	% females devastans	Min. Temp.	Av. Rel. Humidity
15. 6.43	1048	5.3	85.5	71.3	53.5
22. 6.43	565	11.3	79.0	81.1	50.1
29. 6.43	663	15.2	78.4	88.0	53.9
6. 7.43	718	7.1	78.4	84.1	52.9
13. 7.43	1545	1.9	96.7	73.4	66.1
20. 7.43	1185	3.5	73.0	79.9	76.0
27. 7.43	628	4.6	72.4	79.1	80.1
3. 8.43	3007	4.5	88.9	83.0	77.5
10. 8.43	764	10.3	85.7	81.9	82.6
17. 8.43	6149	52.1	82.7	83.1	66.9
24. 8.43	691	36.9	66.4	82.1	65.9
31. 8.43	1897	21.1	71.3	79.3	66.7
16. 9.43[1]	270	17.4	67.6	84.1	66.3
22. 9.43	1112	17.4	67.6	81.9	67.3
29. 9.43	49	22.5	45.5	66.1	56.3
6.10.43	14	7.1	...	65.1	54.6
13.10.43	3	...	...	61.1	58.0
20.10.43	1	...	...	58.7	56.0
27.10.43	8	...	...	54.4	59.7
4.11.43	0	...	...	57.1	66.6
10.11.43	1	...	...	52.8	72.7
17.11.43	4	...	...	49.1	69.9
7. 4.44[2]	20	...	...	58.1	81.1
21. 4.44	524	0.4	...	72.9	48.6
25. 4.44	146	0.7	...	75.1	51.3
3. 5.44	474	0.2	...	70.1	38.4
10. 5.44	28	...	...	73.1	38.1
17. 5.44	1084	0.6	71.4	72.4	51.6
25. 5.44	334	1.2	75.0	76.1	35.6
2. 6.44	179	5.0	55.6	75.1	31.8
7. 6.44	153	5.9	77.8	77.1	47.4
14. 6.44	353	3.4	75.0	76.3	53.4

[1] Light trap was not set up on 7.9.43.

[2] No jassids were collected in the trap between 24.11.43 and 29.3.44. Minimum temperature varied between 38.1 and 55.1. Average relative humidity between 72 and 96.3.

Discussion of Data

(1) *Period of jassid activity.*

The figures in Table I are in conformity with the previous experience (Afzal and Ghani, 1945) at Lyallpur that jassid attack starts early in June, is at its highest in August, and then declines rapidly. There are very few jassids on the cotton plants by the end of September. During the rest of the period very few specimens or none at all were attracted to the light trap. It is, however, known that jassids overwinter in the adult stage, but the number of insects which survive the cold weather must be very small and these also remain very inactive and concealed in places of shelter. Low population and inactivity of the insects are the two probable causes of small or no catches during the cold weather.

(2) *Proportion of E. devastans in different catches.*

E. devastans formed a fair proportion of the total catch throughout the year. The period of activity of this pest, as shown by the catches, coincides with that of the rest of the members of this family. It was attracted to light from the third week of April up to the first week of October, and during the rest of the period not a single specimen could be collected. It formed the highest percentage, 17.4 to 52.1, from the middle of August to the end of September. Thus, although no attempt was made to determine the proportion of the daily catches to the total population of the insect, the numbers caught on the light trap lead one to conclude that, during the season when this pest is most active on the cotton plant, the light trap offers a fairly effective means of attracting it away. The utility of light trap would, of course, be increased manifold if it were placed inside the cotton fields.

(3) *Proportion of sexes in E. devastans collections.*

It is very interesting to note that the number of females of *E. devastans* attracted to light trap in various catches was preponderately high throughout the year. The proportion of the two sexes in the field is almost 50 : 50, but the fact that by far the largest number of females was attracted to the light trap, makes this method a fairly useful and effective measure of control. This is quite contrary to the experience of Wheeler (1937) in the United States, who records that the males of *Empoasca* spp. (*E. fabae* Harr., *E. crigeron* De Long, *E. pergandi* Gill, and *E. solana* De Long) far outnumbered the females in her light collections, though in the fields the proportion of sexes was quite the reverse. This difference may be due either to different species or different environmental conditions, or both.

(4) *Wave length of the light trap.*

The phototropic response of *E. devastans* has not, so far as we are aware, been studied in detail before, and the present work has opened up a line of research which may be followed up. We have, for example, studied the reaction of the insect to white light only, but it is quite possible, as has been found in the case of Aleurodidae, by Deshpande (1936) in India, and other insects by Burks and Ross (1938), Marshall and Henton (1938) in the United States, that lights of different wave lengths may have markedly different attractive capacities.

(5) *Influence of weather condition on the size of the catch.*

The number of jassids collected on different nights at the light trap is very fluctuating. The reason for these variations appears to lie in the weather conditions prevailing during the period of study. Williams (1936) noticed that larger catches of nocturnal insects were obtained in Britain during dark and cloudy nights, the cloudy nights being associated with warmer conditions. Carruth and Kerr (1937) have observed in the United States that the light trap collections were appreciably influenced by night temperatures, and that the collection fell considerably when the minimum temperature sank below 60° F. Afzal Husain *et al* (1934) studied the phototropic response of *Platyedra gossypiella* Saund. in the Punjab and came to the conclusion that it depended largely on temperature. They also found that moonlight affected the phototropic activity adversely. Sorensen (1939) found that *Lygus hesperus* Knight and *Lygus elisus* Van Duzee were attracted to light only on warm cloudy nights. Leach and Mullin (1942) have recorded that distinct peaks of activity of aster leafhoppers, as judged by the light trap collections, occurred during periods of successive warm nights.

In order to elucidate the effect of weather conditions on the number of jassids caught, the minimum temperature and the average relative humidity are shown against weekly catches in Table I. Very few figures of rainfall were available, and as the relative humidity is conditioned by the rainfall, the latter factor only was taken into consideration. It may be mentioned that in the absence of self-recording meteorological instruments no continuous records of temperature or humidity were available. The figures given in Table I are the routine figures available from the Pakistan Meteorological Department. The minimum temperature is the lowest temperature reached at any time during the night. The figures of humidity indicate the average relative humidity of the previous week.

To assess the effect of temperature and humidity on the size of the catch, the figures of weekly catches in Table I were smoothed out by taking log (n + 1) and their correlations worked out.

(a) *Effect of temperature and humidity on catches.* It will be seen from Table I that very few insects were attracted to light when the minimum temperature fell below 70° F., and none at all when it sank below 52° F. The largest catches were obtained when it ranged from 72° to 88° F. The simple correlation between catches and minimum temperature was worked out as follows:

Light trap catches and minimum temperature

$$r = +0.9328 \text{ Highly significant}$$

The correlation was significant up to one percent level and was a positive one, showing thereby that the number of insects collected was greatly influenced by the temperature, and it increased with the increase in minimum temperature.

The simple correlation between catches and relative humidity was as follows:

Light trap catches and relative humidity

$$r = -0.5482 \text{ Highly significant}$$

The correlation in this case also was significant up to one percent level, but was a negative one, showing thereby that the number of insects attracted was also influenced by the relative humidity; it increased as the humidity fell, and vice versa.

It will be seen from the foregoing that both these correlations were highly significant, but an integrated effect of both these factors on the catches can only be found out by working out the partial correlations, as it is only then that the actual effect of each factor can be accurately assessed. The partial correlations were worked out and are given below:

Partial correlation coefficient between catches and relative humidity keeping minimum temperature as constant

$$= 0.1122 \text{ Non-significant}$$

Partial correlation coefficient between catches and minimum temperature keeping relative humidity as constant

$$= 0.9037 \text{ Highly significant}$$

It will be noticed from above that the partial correlation coefficient between catches and humidity was non-significant, while it was significant at one percent level between catches and minimum temperature. This shows that humidity played very little part, and size of the catches on different nights was mainly influenced by minimum temperature. This finding is very interesting, as the

total number of jassids, as well as of other insects, falls down considerably during the winter months. Thus when temperature goes down, the number of insects, as well as their activity, also declines.

(b) *Effect of moonlight on catches.* It is very difficult to separate the effect of moonlight from various other factors which influenced the size of the catch, as by the time the opposite phase of the moon appeared the weather conditions were changed to a considerable extent. Moreover, the observations were taken at weekly intervals. During this period both the phase of the moon and weather conditions changed and thus it became difficult to assess the effect of the two separately.

Summary

The phototropic response of family Jassidae, with special reference to cotton jassid, was studied for a complete year at Lyallpur. A light trap with 100 candle power lamp was put up once a week from dusk to dawn. The total number of jassids, the proportion of *E. devastans,* and the proportion of females in the *E. devastans* collections, were worked out from the weekly collections.

It was seen that jassids were attracted to light from the end of April to the end of September. The percentage of *E. devastans* was highest in catches from the middle of August to the middle of September. The percentage of females in the *E. devastans* collections was preponderately high throughout the course of the year.

An attempt was made to study the influence of weather conditions on the catches. It was seen that largest number of jassids were collected when the minimum temperature ranged from 72° to 88° F. This showed that jassids preferred warm nights for their nocturnal activities.

The correlation coefficient between catches and minimum temperature was positive and highly significant (+0.9328), while it was negative and highly significant between catches and relative humidity (−0.5482). The partial correlation coefficient was significant in the case of catches and minimum temperature (0.9037), while it was non-significant in the case of catches and relative humidity. This showed that the size of the catch on different nights was mainly dependent upon minimum temperature and that the humidity had very little influence over it. It was, however, not possible to separate the effect of moonlight on the size of the catch, from the various other factors that influenced it.

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